Chronic Obstructive Pulmonary Disease

ᢵ COPD is a disease that is **directly related to smoking**.

• Smoking related diseases;

➝ Smoking is major killer; about 5.4 million every year die because of "smoking related diseases ", one every 6 seconds. One of the major killers is the ***cardiovascular diseases***, nearly 1.7 million people died because of it. Almost one million died due to ***COPD*** and less than a million like around 850,000 from ***lung cancer*.**

➝ In the United States there are around 445,000 deaths every year from COPD, as it's the fourth leading cause of death there.

So it is a very common disease and it's a killer!

• COPD is an abbreviation for > **Chronic Obstructive Pulmonary Disease**

Note: Asthma is an obstructive disease but not included in COPD.

• In COPD we have two chronic diseases > **Chronic Bronchitis** & **Emphysema**

ᢵ Definition:

• A disease state characterized by airflow obstruction, it means that the airways in other words "the tubes that transmit the air from the atmosphere to the lung parenchyma where the air exchange occurs" are limited and obstructed.

- **It's not fully reversible** and that's how we can differentiate it from asthma "as it's a reversible disease".
- its usually **progressive** ya3ni as far as you are still smoking the area of obstruction will get worse with time but if you stop smoking you will limit the progression of the disease but the lungs will not go back to their normal state.
- There will an **inflammation in the airways** and this inflammation is due to noxious particles like the chemicals found in smoking which are the major ones.
- **It's preventable,** because if you are not a smoker u will probably never get COPD unless you are exposed to other risk factors.
- **It's treatable;** so it can be treated but it's not curable, we can stop its progression and control it but not cure it!

- We said that we have to diseases in COPD;

1) **Chronic Bronchitis:** anyone that has cough and sputum production for most of the days, for 3 consecutive months or 3 months in a year for 2 consecutive years. Provided that he doesn't have underlined lung disease, for example; someone who has bronchitisis "which means dilatation and destruction in the airways "they will cough and sputum all their lives and this is different.

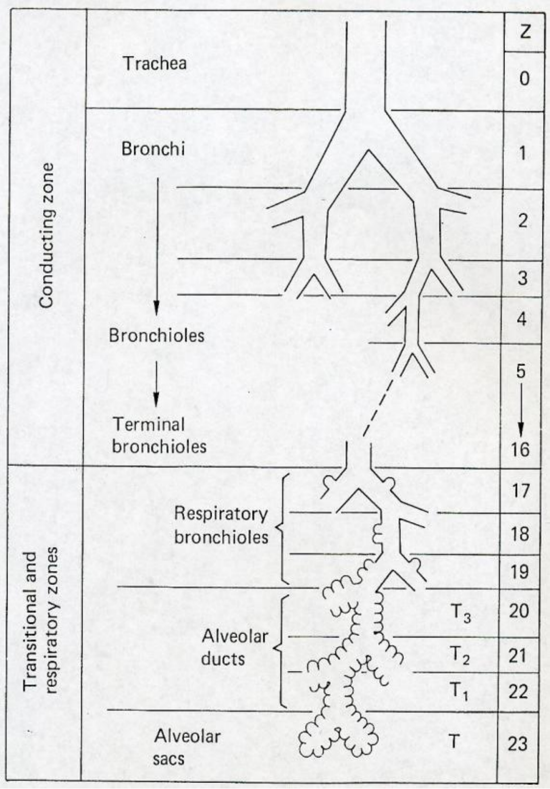
2) **Emphysema :** which is permanent airspace dilatation beyond the terminal bronchiole

- In the past probably before the 80's (before the invention of the CT scan) it was difficult to diagnose Emphysema but they used to consider the symptoms & the chest x-ray that days to diagnose, while nowadays with the high resolution CT scans we define it and NO ONE ever takes a lung biopsy to diagnose Emphysema.

- Respiratory module;

◆ **Conducting part** → The conducting airways in the respiratory track started from the nose down, after the larynx we have the bronchial tree where the trachea divides into two parts "bronchi" and those keep dividing until 17 generations of divisions . they take the air from the atmosphere down to the gas exchange unit "alveolar sac". Chronic bronchitis is a disease in this part.(only in the conducting not the gas exchange)

◆ **Transitional** & **respiratory part**→ which is the gas Exchange part, Emphysema happens in this part in the Gas exchange unit where we have destruction and dilatation of that unit.



Difference between Asthma & COPD; (Chart in slide # 10)

- *Asthma:*

1) The **trigger** is: sensitizing & allergic agents wither its allergy from something in the air or from the atmosphere like the grass and animals or even sometimes it can be a food allergy.

2) The **inflammation here is driven by**: CD4+ cells & eosinophils are the main cells

3) Air flow limitation > ***completely reversible***

- *COPD:*

1) The **trigger** is; Noxious agent or particle which is mainly in smoking or those who work in mining.

2) **Inflammation driven by**: CD8+ T-Cells, macrophages & neutrophils

3) Air flow limitation > ***completely irreversible. (because there is fibrosis, especially around the bronchioles)***

COPD in the United States;

- In the USA about 12 million people had COPD in 2001, till now 2011 it has been estimated to be 16 million people > about 14 million of them are undiagnosed because they will probably smokers and they think that cough and sputum is normal in their case as they are smoking so they don't go to the physician to check unless he develops other signs like hemoptysis he starts worrying and decides to refer to a doctor.

- Of all the six leading causes of death in the United States, COPD is the only one which is increasing by time, so all of the leading causes of death are decreasing except COPD because more people are starting to smoke especially 3rd world countries > they are probably 20-50 years lagging behind developed countries as in the west & states most people are cutting smoking and smoke prevalence is coming down while in the 3rd world countries its rising up (Chart in slide # 12)

- Usually people that have COPD are in their late 40's and 50's

- in the past COPD was more common found in males but with time its rate was rising in females because nowadays women started smoking more especially those in older aged group (40's & 50s). " chart in slide # 13"

ᘓ Risk factors for COPD:

→ The **MAJOR risk factor is smoking**. “Tobacco smoke in all kinds”

• The other risk factors as any other chronic conditions; usually there is an interaction or interplay between the **genetic makeups** of the person, **environmental factors**.

❖ ***Host factors:***

1) The only genetic disease that predispose to COPD “which is emphysema “is the alpha-1 antitrypsin or alpha-1 ant protease deficiency and this is a very rare (less than 1-2 %), autosomal recessive disease. It can be treated if diagnosed early. Usually those patients present with emphysema, if they are;

- **Non smokers** and they are in their late 30’s or early 40' they will develop the disease.
- **Smokers >** it will accelerate the presentation of the disease and they might present with emphysema in their early 30’s.

In Jordan I haven’t seen any patient or probably one or two patients were suspected to have this because we have advanced emphysema and they never smoked so we couldn’t prove that they are related.

2) Airway hyper responsiveness > those who have constricted airway s when they are exposed to non specific stimuli, those are more likely to develop COPD if they are smokers. For example, Histamine or Methacholine, we inhale them in a certain concentration if we have;

- **Normal airways** > they will not constrict even if we reached a concentration of 8 mg/ml of methacholine or histamine
- Patients who have **hyper responsiveness** > their airway will get obstructed, FEV1”Forced expiratory volume in one second” will drop by 20% (I’m not sure :S) if we expose them to histamine or methacholine in a concentration less than 8 mg/ml, so they have a higer risk of developing COPD.

Airway hyper responsiveness is also a major feature of asthma, but not every person who has hyper responsiveness is asthmatic!

3) There are talks about lung growth**,** those who have small lungs at birth will have a higher risk of developing COPD if they smoke later in their lives.

❖ ***Exposures:***

1) As I said before that the major risk factor is the tobacco smoke, any sort of this tobacco is harm whether its cigarettes, cigar or sheesha (haha :P). Even what we call environmental tobacco smoke is hazardous- those who don't smoke but live with smokers.

2) Air pollution is also a contributing factor.

3) Some people think that repeated infections are related as well.

4) Socioeconomic status also is related, those who smoke and if they are at higher socioeconomic status are less likely to develop COPD than smoker with lower socioeconomic status even if they smoked to the same extend.

ᘓ Prevalence of Smoking in Jordan;

• Adults above age 18

→ These are statistics in 2007 > 50 % of males are smokers. However, only 10.5 % of females smoke

• School children 13-15 year

→ 1999 > Males 25%, Females 16%

→ 2007 > Males 37%, Females 26%

So you can see that it's common in children!

ᘓ Pathology of COPD:

• As we said, the chemicals that are found either in smoke or in air pollution or food they **lead to mucous hypersecretion** through the hypertrophy mucous secreting glands in the bronchial tree- if you remember the histology of the bronchial tree > it's pseudostratified ciliated columnar epithelial and in the submucosa we have secreting glands.

- *Again in conclusion* ⇨ All these chemicals that come from smoke & dust and other factors stimulate and lead to hypertrophy of these mucous glands, as we go down in the bronchial tree the goblet cells became more and these also produce mucous, on the other hand those chemicals are inhibitory to the (cilliary function) > "which is very important in the defense mechanism!

- Cilia are very tiny hair like tubules that beat in a coordinated matter any foreign particles. They will get rid of any particles that will get inside the respiratory track or the bronchial tree, so the chemicals in the smoke are inhibitory to the ciliary action that's why these chemical particles will stay there and may lead to repeated infections.

→So the mucous hypersecretion or the ciliary dysfunction is the reason for sputum production and it will stimulate coughing.

- **Air flow limitation**: It means the narrowing of the airway because of the inflammatory cells infiltrate or because of the hypertrophy of mucous glands which will cause narrowing of the lumen of the airway and if there is element of emphysema because chronic bronchitis & emphysema both are smoke related. > "So usually patients have these two diseases together because they are related to the same cause".

The narrowing contbutes to air flow replension and the distruction of the aleveoli that will lead to shortness of breath

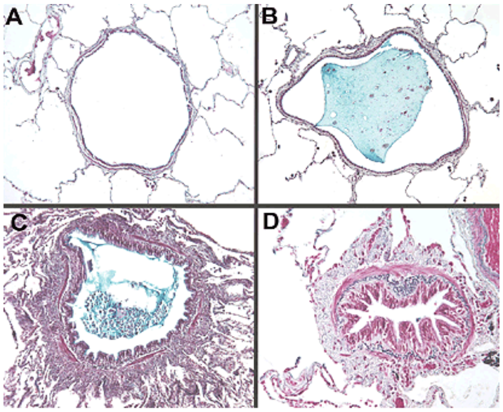
- If the **gas exchange unit is affected** that means that there is emphysema → which will lead to hypoxia→ will cause vasoconstriction of the pulmonary vessels →will lead to pulmonary hypertension → lead to a disease called *Cor pulmonale* "which is right sided hypertrophy (in the right ventricle) with or without heart failure secondary to pulmonary disease" → respiratory failure on long term.

Note: Not every smoker will develop COPD, why? Because it's probably genetically determined, in other word there are some genes that contribute

Probably 20-30% of smokers develop COPD, but even if smokers skip COPD they might have cancer, stroke or ischemic heart disease.

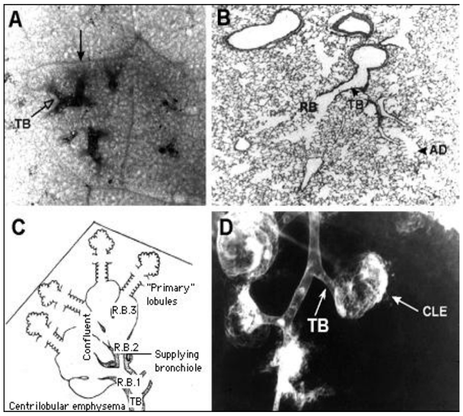
- Chronic bronchitis stages:

- The **mild** one, there is mucous inside the airways that will contribute to the airway obstruction and little inflammation.
- **it grows more** > more infiltrate .
- in the **severe one** there is fibrosis "fibrosis around the bronchioles" that's why its permanent & irreversible.



•This how emphysema looks like:

- You will find dilated vesicles.
- The **emphysema of the smoker** is called > *centrilobular emphysema*.(Usually affects the upper lobes more than the other parts of the lungs)
- The **emphysema that is from alpha-1 antitrypsin Deficiency** is called > *panacinar emphysema* (Affects the lower lobes)



mechanisms of airflow limitation:

• The mechanism of airway limitation is the inflammation that will lead to small airway disease. In these small airways there will be inflammatory cells infiltrate and mucous glands hypertrophy → All these contribute to the narrowing of the airway.

• The parenchymal destruction will lead to loss of elastic support of the airways. The airways are patent because there is elastic tissue in the alveoli which are around the small airways. If they are constricted the airways will get collapsed.

• So both emphysema and chronic bronchitis contribute to airway obstruction. So emphysema is hyperinflation of the lung, you expect that the airways will be more dilated. But what happens is the reverse, because of the loss of the elastic tissue, the airways will get collapsed.

Diagnosis of COPD:

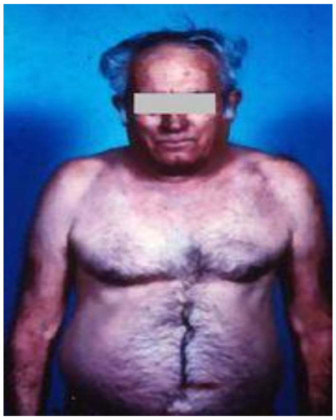
•The diagnosis of COPD starts with the symptoms , like any other disease , but we have to differentiate between COPD and other diseases like emphysema and chronic bronchitis , we might have a pt. with chronic bronchitis but does not have COPD .

• **Main symptoms of COPD are** : cough , sputum production , dyspnea (shortness of breath)

•*Pulmonary function test* : we do it only for whom we suspect having the disease .

- Pts. who develop chronic bronchitis predominantly are obese , have chronic cough and sputum production , and after a while , they will develop a right sided heart failure , these pts are referred to be described by the term **“ Blue-Bloaters**” (pic1)

Blue : cyanosed because of the respiratory failure
Bloaters : edematous because of the right sided heart failure

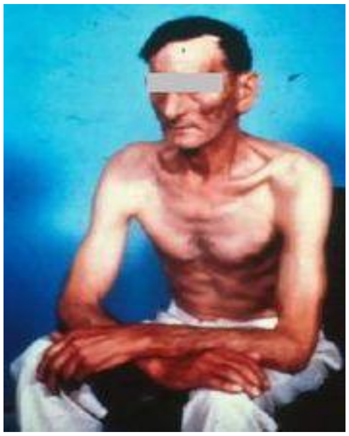


Pic 1

- While pts who have emphysema are described by the term “**Pink-Puffer”,** they are usually thin, they develop cyanosis but mostly at the end stage of the disease (pic2)

- Majority of pts have a combination of both.

• Radiographs: are used for detecting the complications of COPD Pneumothorax , cancers …etc.



Pic 2

Pulmonary function test readings :

• The hallmark in the detection of COPD is what we call **FEV1/FVC** , and it **should be less than 70** .

- FEV1: is the forced expiratory volume in the first second i.e. It’s the maximum amount of air that we can expel after a deep inspiration.
- FVC : forced vital capacity : is the amount of air that can forcibly be blown out after a full inspiration and its measured by liters

• Normal adults will have 80% FEV1/FVC and in COPD it will be less than 70 % because of the narrow airways.
• The number of FEV1 will be variable
• If we measure the airway resistance, it will be increased also, because of the inflammation that lead to narrow airways
• The total lung capacity will be increased because it will be inflated

• The residual volume will be increased specially in emphysema

• The diffusion capacity : and this is an estimate to the gas exchange limit in the lungs , usually carbon monoxide is used :

- In ***chronic bronchitis*** → it will be normal because as we said chronic bronchitis is a disease of the conductive airways and the conductive airways have nothing to do with the gas exchange
- In ***emphysema*** → the diffusion capacity is reduced because emphysema is a disease where the gas exchange takes place .

Usually after the age of 25 , our pulmonary function starts to decline

• In every spirometry we have the predictive value measures and it consist of three things : sex, height, age

• COPD is classified into four grades according to the severity :

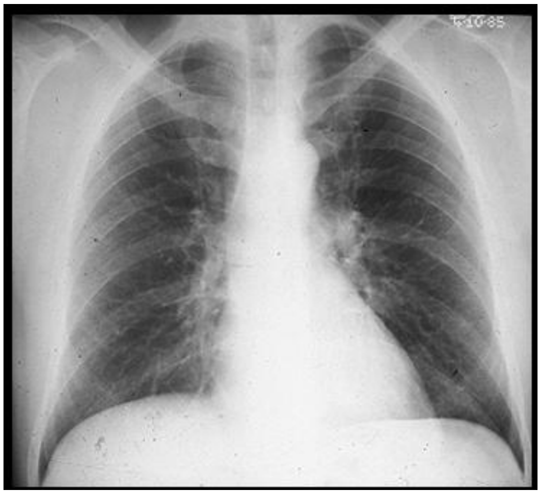
Stage I: Mild	$FEV_1/FVC < 70\%$ $FEV_1 \geq 80\%$ predicted
Stage II: Moderate	$FEV_1/FVC < 70\%$ $50\% \leq FEV_1 < 80\%$ predicted
Stage III: Severe	$FEV_1 /FVC < 0.70$ $30\% \leq FEV_1 < 50\%$ predicted
Stage IV: V. Severe	$FEV_1/FVC < 0.70$ $FEV_1 < 30\%$ predicted *or* $FEV_1 < 50\%$ predicted *plus* chronic respiratory failure

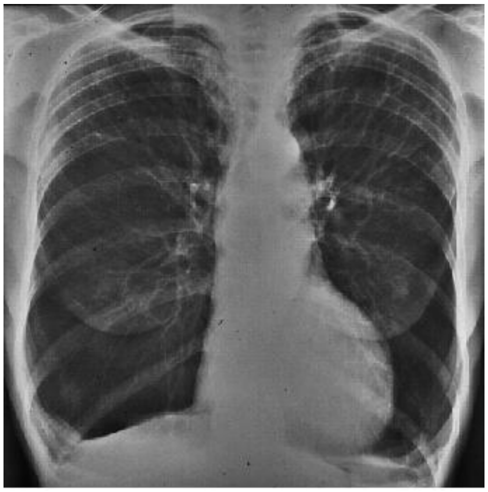
* numbers are only for reading

→ If a smoker had a stage I COPD and stopped smoking , he will have no irreversible respiratory damage, in contrast to a sever stage of COPD pts , It'll be irreversible.

X-rays

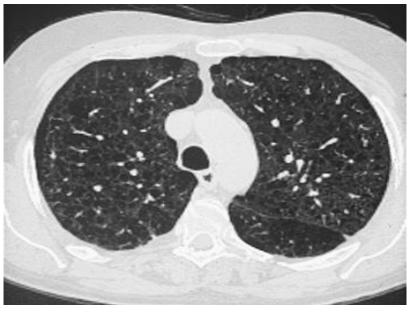
- Normally, we don’t do x-rays for COPD pts, unless there is complications, like pneumothorax or pneumonia , that will complicate the situation , also if we are afraid of a neoplastic development , because COPD and lung cancer pts share the same risk factor (SMOKING)



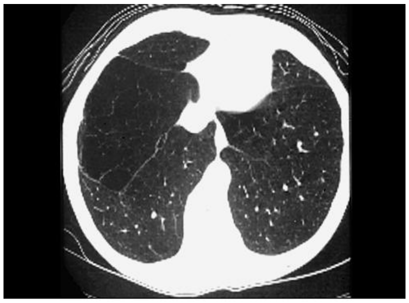


- This is to show you the difference between a normal chest x-ray (left) and a COPD x-ray (right), u can notice the hyper expansion in the thoracic area and that’s due to the inflation of the lungs.

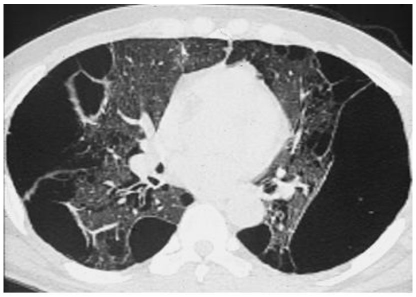
- This is a CT scan showing a **centrilobular emphysema** , and the bronchovascular markings are reduced because of the destruction and appear like holes .



- This is what we call a **panacinar emphysema or panlobular emphysema** , there almost no bronchovascular markings because of the destruction .



- This is what we call “Bullous Disease“ and you can notice the big hole in the middle that has been formed by the union of the small holes



Treatment of COPD:

→ First , we try to prevent the progression of the disease , and that is done by the correction of the risk factor , like if the pt is a smoker , he should quit smoking , and nicotine replacements , anti-depressants and varinicline (nicotine receptor agonist) can be given .

  - Also vaccines are given to COPD pts , especially in winter as the symptoms like cough increase

→ Improve the pulmonary function: and this is done by medical treatment, rehabilitation and surgical options
→ Finally treatment of the complications of COPD

Management of COPD:

- Reduce the risk factors ➧ quit smoking , changing occupation(coal mining) , vaccination .

- If there were shortness of breath ➧ short acting β2 agonist can be given

- As COPD gets more sever ➧ a long acting β2 agonist is given when needed

- Corticosteroids are helpful in advanced stages of COPD
- If a respiratory failure is developed a long term oxygen therapy (LTOT) is an option with the surgical treatment

Surgical treatment:

- It’s a very limited option ,
  - **Lung volume reduction surgery;** its for pts with predominant emphysema and the upper lobes are destructed , the upper lobes can be removed , after the confirmation by a CT scan.

- **Bullectomy** : if the pt has a very large Bullous like what we have seen in the Bullous Disease and its compressing the healthy tissue , it's can be removed

- **Lung transplantation** : mainly for α1-antitrypsin deficiency patients

ᘓ Treatment for acute exacerbation:

• Exacerbation : increased cough and shortness of breath and sputum production .
- *Oxygen therapy*
- *Bronchodilators*
- *Antibiotics:* The decision of choosing the right antibiotic depends on the organism and the severity of the disease. (Main organisms causing exacerbation are : **Haemophilus influenzae ,Moraxella catarrhalis,** and **Streptococcus pneumonia**
- *Corticosteroids :* orally or parentally according to the severity
- *Assisted ventilation*

ᘓ Treatment of respiratory failure:

A long term oxygen therapy is the solution in two cases of respiratory failure :

→ If the **PaO2 < 7.3 Kpa (55 mmhg**)
→ If **PaO2 = 7.3 – 8 Kpa (55-60 mmhg**) and there is an evidence of corpulmonale or secondary polycythemia

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